A SECOND revised edition of "An Elementary Geography of India, Burma, and Ceylon," by Mr. Henry F. Blanford, F.R.S., has been published by Messrs. Macmillan and Co., Ltd. The important changes which have been made in Indian geography since the appearance of the first edition of the book have caused the author to re-write several portions, and to add new chapters on the North-west Frontier Province and on the Laccadive and Maldive Islands.

WE have received from the Wentworth Publishing Co., of Surrey Street, W.C., a copy of their new "Seaside and Inland A.B.C. Holiday Guide." The book runs to 311 pages, and contains concise descriptions of all health and pleasure resorts and places of interest in the United Kingdom. Lists of all the golf links throughout the kingdom, of all British spas, of the principal angling stations, and of the coaching centres are also provided. This useful guide costs one shilling net.

ACCORDING to a communication of J. Knett which appears in the *Sitzungsberichte* (No. 11) of the Vienna Academy of Sciences, the thermal springs of Karlsbad deposit small yellow tabular crystals of barium sulphate which are distinctly radio-active, and show all the phenomena characteristic of the presence of an active element.

THE May number of the *Physical Review* contains interesting papers on "Potential Phenomena in Vacuum Tubes during the Production and Interruption of Electrical Discharge," by S. N. Taylor, and "Observations on the Radiation produced in an Alternating Condenser Field," by F. Sanford.

THE investigation of certain complex cerium compounds by Prof. B. Brauner, an account of which appears in the current volume, No. 39, p. 261, of the *Zeitschrift für anorganische Chemie,* throws considerable light on the nature of certain cerium compounds which have been the subject of discussion for several decades. The red coloured salt which separates from the solution obtained by the action of water and sulphuric acid on oxide of cerium is shown to be the acid cerous salt of the complex cerisulphuric acid, and is represented by the formula

$$Ce^{iv}(SO_4)_4Ce^{iii}H.12H_2O.$$

Perfectly similar compounds, in which the trivalent cerium is replaced by lanthanum, neodymium and praseodymium, have also been obtained.

SOME interesting facts relating to the influence of the application of potash salts on the agricultural production of Prussia are contained in a recent address by Dr. Carl Ochsenius to the Philadelphia Academy of Sciences. In 1893 the consumption of potash in German agriculture was 60,000 tons, in 1903 it was 150,000 tons. The following numbers give the yields per hectare in kilograms of different kinds of produce for the two years in question :—

	Summer wheat	Summer rye	Summer barley	Oats	Clover and Lucerne	Hay
1893	1477	872	1517	1067	2249	2275
1903	2304	1023	1988	1837	5250	4056

THE existence of a urea-forming enzyme has recently been demonstrated by Kossel and Dakin (*Zeit. physiol. Chem.*, xli., 321, &c.). The enzyme occurs principally in the liver, but is also present in the thymus gland, mucous membrane of small intestine, kidney and lymphatic glands. It possesses the property of causing the rapid decomposition of arginine (δ-guanido-α-amidovaleric acid), which is one of the end products of tryptic digestion, into ornithine (αδ-diamidovaleric acid) and urea. The enzyme may be roughly isolated by precipitation of extracts of liver with alcohol and ether, or with ammonium sulphate, and may be preserved in the solid form for many months with but little change. The conversion of arginine into urea and ornithine illustrates a new type of enzyme reaction. The enzyme has been named "arginase," and is the first representative of the class of urea-forming enzymes capable of being isolated and of acting outside the body.

OUR ASTRONOMICAL COLUMN.

COMET 1904 *a*.—A new set of elements and an ephemeris for this comet are published in No. 3947 of the *Astronomische Nachrichten* by Prof. Strömgren. These vary but slightly from those previously published by Herr Ebert. Observations made on May 19 gave corrections of −41s. in R.A. and +2′·2 in declination to the positions, for that date, derived from Prof. Strömgren's elements, thereby showing the latter to be fairly correct. From this fact it follows that the object which appeared on the Harvard photographs of March 11 and 15, which was thought to be this comet, must have been some other body, for its position is about 6° from the comet's position on that date as deduced from these elements.

The comet's orbit is probably parabolic, and is noteworthy for its large perihelion distance, somewhat similar to that of Giacobini's comet of 1902–3 (the *Observatory,* No. 345).

DURATION OF THE PERSEID SHOWER.—In a letter to the *Observatory* (June), Mr. Denning directs attention to the long duration of the annual shower of Perseids. He states that the shower is certainly active by July 19, and that it has not entirely ceased on August 16; there is some evidence that traces of it have been observed as early as July 7 and as late as August 25, a period of fifty nights.

Mr. Denning also gives a list of radiants for various stages of the shower, derived from the collected observations made during the period 1877–1903 inclusive.

Moonlight will not interfere with the observation of either the earlier stages (July 8–19) or the maximum and latest phases (August 6–19) of this year's shower.

FOUNDATION OF A NEW ASTROPHYSICAL OBSERVATORY.—A letter from Dr. C. Nordmann to the *Revue générale des Sciences* (No. 10, May 30) describes the aims and equipment of a new astrophysical observatory which has just been built near to Tortosa, in Spain, in latitude 40° 48′ N. and longitude 1° 47′ E. of Paris.

The general idea of the work to be prosecuted is to obtain information regarding the relations between solar and terrestrial phenomena, relations the existence of which has of late years been abundantly confirmed by all workers in solar physics.

Two magnetic houses have been equipped, the one for absolute measures of terrestrial magnetism, the other for obtaining records of the regular variations in the elements and of the extraordinary disturbances which appear to coincide, in point of time, with solar disturbances.

The observatory is also to be furnished with an equatorial for observing sun-spots, an Evershed photo-spectroheliograph, and an instrument for determining the radial velocities of solar prominence eruptions.

Another building has been set apart for meteorological observations and the study of atmospheric optics, and seismological observations have also been provided for.

THE TOTAL SOLAR ECLIPSE OF 1905.—In an article published in the *Popular Science Monthly* for June, Prof. W. W. Campbell gives an interesting *résumé* of what has already been achieved by eclipse expeditions, and indicates the present state of our knowledge regarding eclipse phenomena. He then suggests a number of observations which might be profitably made during the eclipse of May, 1905. Amongst these he considers the search for an intra-mercurial planet to be of prime importance. The observations of Perrine in 1900 seemed to negative the idea of such a planet's existence, but no *definite* conclusions could be formed owing to the intermittently cloudy state of the

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sky at the time when the photographs were taken. Prof. Campbell suggests that cameras similar to those used by Perrine should be used in Labrador, Spain, Tunis, and Egypt. He also insists upon the necessity for setting up coronagraphs at each of these widely separated stations in order to determine whether or not any real changes take place in the corona during the eclipse.

The determination of the correct wave-length of the chief corona line is also suggested as being of great importance. Finally, he urges upon observers the vital importance of thoroughly testing all their instruments before leaving home, and of allowing themselves plenty of time to make the final adjustments whilst in the eclipse camp.

ACTUAL DISTANCES BETWEEN STARS.—By simple trigonometrical calculations, Mr. J. E. Gore has deduced some interesting facts regarding the probable actual distances between certain stars the parallaxes of which are known with some degree of certainty. Thus he has determined that Sirius and Procyon are separated by about half the distance between the former star and our own system, therefore Sirius as seen from Procyon would appear as a star of magnitude −3·08. In the case of η and μ Cassiopeiæ, the actual distance between them is probably about one-fifteenth their distance from the sun, and their apparent brilliancies would therefore be about 225 times as great as they appear to us. In the case of double stars, these figures become much greater; for example, if we take 61 Cygni, the distance separating the components is about 55 astronomical units, and, as they are probably situated at some 515,662 astronomical units from the earth, their apparent brightness would be increased about 88 million times, or by 19·8 magnitudes, if seen at the distance which separates them. Similarly, the brightness of each of the components of α Centauri would be increased by 19·7 magnitudes (the *Observatory*, No. 345).

THE SUCCESSION OF CHANGES IN RADIO-ACTIVE BODIES.[1]

IT has been shown by Rutherford and Soddy that the radio-activity of the radio-elements is always accompanied by the production of a series of new substances possessing some distinctive physical and chemical properties. These new substances are not produced simultaneously, but arise in consequence of a succession of changes originating in the radio-elements. The radio-activity of these products is not permanent, but diminishes in most cases, according to an exponential law with the time. Each product has a distinctive rate of decay of activity, which has not, so far, been altered by any physical or chemical agency. The law of decay has been explained on the supposition that the product undergoes change according to the same law as a mono-molecular change in chemistry. The change occurs in consequence of the expulsion of an α or β particle, or both, and the activity of a product is thus a measure of its rate of change. While the products, like the emanations, and UrX, lose their activity according to an exponential law, the matter emanation X, which gives rise to the phenomena of excited activity, does not lose its activity according to a simple law. The experiments of Miss Brooks and the author, and of Curie and Danne, have shown that the decay of the excited activity of radium is very complicated, and depends upon the time of exposure to the exciting cause, viz. the emanation. The author has shown that the excited activity produced in a body by a short exposure in the presence of the thorium emanation increases at first for a few hours, passes through a maximum value, and then decays with the time according to an exponential law.

In the paper the curves of decay of excited activity of radium and thorium are given for both short and long exposures to the emanations, and it is shown that the law of change of activity with time can be completely explained on the theory that emanation X of thorium and radium is complex, and undergoes a series of successive changes.

The mathematical theory of successive changes is given in detail, and a comparison is made of the theoretical and experimental curves obtained for the variation with time of the excited activity. In the case of thorium, two changes are found to occur in emanation X. The first change is a "rayless" one, *i.e.* the transformation is not accompanied by the appearance of α, β, or γ rays. The second change gives rise to all three kinds of rays.

The decay of activity of emanation X of radium depends greatly on whether the α or β rays are used as a means of measurements. The curves obtained by the β rays are always identical with those obtained by the γ rays, showing that the β and γ rays always occur together and in the same proportion. The complicated decay curves obtained for the different types of rays, and for different times of exposure, can be completely explained on the supposition that there are three rapid successive changes in the matter deposited by the emanation, viz. :—

(1) A rapid change, giving rise only to α rays, in which half the matter is transformed in about three minutes.

(2) A "rayless" change, in which half the matter is transformed in twenty-one minutes.

(3) A change giving rise to α, β and γ rays together, in which half the matter is transformed in twenty-eight minutes.[1]

A similar rayless change is shown to occur in the "emanating substance" of Giesel.

The occurrence of a rayless change in the three radio-active bodies is of considerable interest. Since the change is not accompanied by rays, it can only be detected by its effect in the change or changes which follow. The matter of the rayless change is transformed according to the same law as the other changes. The rayless change may be supposed to consist either of a rearrangement of the components of the atom or a disintegration of the atom, in which the products of the disintegration are not set in sufficiently rapid motion to ionise the gas or to affect a photographic plate. The significance of the rayless changes is discussed, and the possibility is pointed out that similar rayless changes may occur in ordinary matter; for the changes taking place in the radio-active bodies would probably not have been detected if a part of the atom had not been expelled with great velocity.

The radiations from the different active products have been examined, and it is shown that the β and γ rays appear only in the last rapid change of each of the radio-elements. The other changes are accompanied by the emission of α particles alone.

Evidence is given that the last rapid change in uranium, radium, and thorium, which gives rise to β and γ rays, is far more violent and explosive in character than the preceding changes. There is some evidence for supposing that, in addition to the expelled α and β particles, more than one substance is produced as a result of the disintegration.

After the three rapid changes have taken place in emanation X of radium, there remains another product, which loses its activity extremely slowly. Madame Curie showed that a body, which had been exposed for some time in the presence of the radium emanation, always manifested a residual activity which did not appreciably diminish in the course of six months. A similar result has been obtained by Giesel. Some experiments are described, in which the matter of slow decay, deposited on the walls of a glass tube containing the emanation, was dissolved in acid. The active matter was found to emit both α and β rays, and the latter were present in unusually large proportion. The activity measured by the β rays diminished in the course of three months, while the activity measured by the α rays was unaltered. The active matter was complex, for a part which gave out only α rays was removed by placing a bismuth plate in the solution. The radio-active matter deposited on the bismuth is closely allied in chemical and radio-active properties to the active constituent contained in the radio-tellurium of Marckwald. The evidence, as a whole, is strongly in support of the view that the active substance present in radio-tellurium is a disintegration product of the radium atom. Since the radium emanation is

[1] Bakerian Lecture delivered at the Royal Society on May 19 by Prof. E. Rutherford, F.R.S.

[1] A statement of the nature of the three changes occurring in emanation X of radium was first given in a paper by Rutherford and Barne (*Phil. Mag.*, February). A brief account of the theory from which th results were deduced has been given in my book "Radio-activity" (Cambridge University Press). Later, Curie and Danne (*Comptes rendus*, March 14) arrived, in a similar way, at the same conclusions.

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